Appendix C: Delaware Estuary TMDL Coalition's Proposal for a Collaborative Scientific Process

Delaware Estuary TMDL Coalition

Proposal for a Collaborative Scientific Process: Development of the PCB Model

I. INTRODUCTION

Developing a model that accurately represents PCB fate and transport is one of the most critical steps in establishing a scientifically credible TMDL for PCBs in the Delaware Estuary ("the Estuary"). Constructing and calibrating such a model is not a simple task given the numerous sources and pathways for PCBs to enter the Estuary, the complexities involved in assessing the important fate and transport processes, and the spatial and temporal variability of conditions in the Estuary. In addition, while DRBC has not yet finalized a revised PCB water quality standard, it is likely that the target for the PCB TMDL will be extremely low, thus requiring a model with great accuracy and sensitivity so that it can act as an effective risk management tool. For these reasons, the Delaware Estuary TMDL Coalition ("Coalition") believes that development of the PCB Model for the Estuary ("the Model") should be a truly collaborative effort that draws upon the combined capabilities and experience of the most knowledgeable experts in the field.

The Coalition is encouraged by DRBC's prompt appointment of Dr. James Martin to the Expert Panel following the resignation of Dr. Kevin Farley, and by DRBC's decision to utilize principals and staff from Limno-Tech as its modeling experts. The Coalition further believes that these actions are a positive step forward and will assist the DRBC in resolving the complex technical issues associated with the PCB TMDL.

The Coalition and its Technical Committee have reviewed the current status of DRBC's efforts to characterize and understand the fate and transport of PCB loadings in the Estuary. The Coalition's findings are set forth in this document, which has three objectives - the identification of: 1) issues critical to the development of a model, 2) proposed approaches for addressing those issues, and 3) areas where the Coalition can provide assistance to the DRBC with respect to resolving those issues.

A. Issue Identification

This document identifies what the Coalition believes to be the key and/or time-sensitive modeling and associated data collection and scientific issues on which the DRBC and the stakeholders need to focus their resources so that the TMDL process can move forward in an efficient, timely and scientifically sound manner. Given its focus on critical and/or time-sensitive modeling issues, it is not intended as a comprehensive list of all issues that ultimately need to be addressed.

Perhaps the most critical of all issues in establishing a collaborative scientific process is the need for stakeholders to gain timely access to the data that currently are being used to develop the framework of the Model. A true collaborative scientific process requires that the stakeholders be afforded the opportunity to develop a comprehensive understanding of these data (including the physical measurements, the processes used to determine the representative sampling locations for extrapolation to the entirety of the Estuary, sampling methods and protocols, and the accuracy and precision of the measurements) as the Model is being developed.

In addition to data access, there are a number of important issues related to the framework, inputs, and implementation of the Model. The Coalition has identified several such issues based on a review of the First Cut Homolog Model (DRBC, 2001) and additional information shared by the DRBC and LimnoTech at the June 27, 2002 meeting of the Expert Panel. These specific issues are outlined in Section III of this document.

B. Proposed Solutions

This document identifies what the Coalition believes to be workable and realistic solutions to address the issues that have been identified so that the process can move forward in a timely and efficient manner. Proposed solutions to identified modeling issues are presented in Section III. Due to the complexity of the model and the strong interrelationship between and among the processes and inputs needed to accurately calibrate and apply the model, some of the solutions address multiple issues.

C. Assistance

This document also discusses the assistance that the Coalition can offer to the DRBC in implementing the proposed solutions, and establishing a collaborative scientific process. Specific Coalition proposals to assist the DRBC are outlined in Section II.

II. COALITION'S ASSISTANCE TO THE DRBC

In order to address the critical issues and move this process forward, the Coalition will provide the following immediate assistance to DRBC.

A. Technical Workshop

As approved by the DRBC's Toxics Advisory Committee ("TAC") at its May 7 meeting, and reaffirmed at the June 27 Expert Panel meeting, the Coalition will take the lead in organizing and will fund a two-day Technical Workshop/Science Forum. This Technical Workshop/Science Forum will include technical presentations of results from the key studies that have been conducted to help develop the TMDL, and discussions about how these findings will be used to help develop the TMDL model. Specific objectives of the Technical Workshop/Science Forum are to:

(1) Summarize the data and key findings from recent studies,
(2) Discuss how these findings can/will be used to inform the model,
(3) Identify and discuss points of agreement/disagreement regarding the model conceptual framework, and
(4) Identify any additional data needs.

This Technical Workshop/Science Forum will be thoroughly scientific in nature and will not involve discussions about policy. Attendance at this event will include the principal investigators who performed the various studies and data collection efforts, and members of the TAC, including DRBC staff and their consultant (Limno-Tech, Inc.), Expert Panel members, regulatory/resource agency representatives (EPA, States, USFW), and representatives from the Coalition. Any interested stakeholder will be welcome to observe the proceedings; however, active participation will be limited to the scientists and modelers. A rationale and draft agenda for this Technical Workshop/Science Forum is provided in Attachment A. A Steering Committee is being formed and will begin shortly to finalize plans for this important meeting (see Attachment A).

B. Modeling Experts Work Group

The Coalition also proposes to organize and help fund working sessions for the modeling experts ("Modeling Experts Work Group") on a monthly or some other regularly scheduled basis, as the modeling experts deem appropriate. At present, the framework of the Model is being developed without a mechanism for stakeholders to provide timely input or to gain a timely understanding of the decision processes that affect the framework and calibration of the Model. The opportunity for any substantive exchange of information is currently limited to the Expert Panel meetings, which are generally held four months apart.

The objective of the proposed working sessions is to facilitate more frequent and better communications among the experts in a forum that will foster open discussion and proposals for resolving the highly complex and technical issues confronting the DRBC in developing this TMDL model. If this objective is to be achieved, participants in the working sessions should receive all data and information as well as relevant work products that have been collected and or developed since the prior meeting. Consistent with this objective, interested stakeholders would be welcome to attend the working sessions as observers; however, participation would be limited to scientists and modelers with the requisite experience and understanding to discuss and resolve the technical issues.

With respect to funding, the Coalition is willing to defray any expenses associated with staff from HydroQual's preparation for and participation at the working sessions, to make Coalition members' in-house expert scientists/modelers available for the working sessions, to provide meeting facilities and to contribute toward the costs of having LimnoTech and the Expert Panel members participate in these working sessions.

C. DRBC Funding

The Coalition will support DRBC's efforts to obtain independent funding from other sources for targeted tasks to assist in data acquisition, model development and implementation. For example, the City of Philadelphia through the Philadelphia Water Department ("PWD") has already offered to fund additional tributary sampling work.

D. Data Exchange

The Coalition proposes to work cooperatively with the DRBC, the Principal Investigators and Expert Panel to develop and implement a process for sharing data and information to be used as modeling inputs. This will facilitate the establishment of the collaborative scientific process. With a timely exchange of data, all stakeholders will be better able to reach consensus on the magnitude of the PCB problem in the estuary and work toward effective solutions. In addition, the creation of an archive of historical reports and data that are foundational to the DRBC work should be created, and all stakeholders should be invited to submit relevant information, for stakeholder review.

The Coalition believes that implementation of these strategies would represent a positive step forward in addressing many of the unresolved issues surrounding the development of this TMDL. These activities, along with open communications among all parties, will support the type of collaborative effort necessary to ensure that the PCB model will be a reliable tool in the TMDL process. The remainder of this document describes some key issues the Coalition believes should be evaluated and resolved by the expert scientists and modelers at the monthly working sessions.

III. IDENTIFICATION OF CRITICAL ISSUES AND PROPOSED SOLUTIONS

A. Introduction

A fate and transport model, such as the one being developed by the DBRC for PCBs in the Estuary, must be calibrated against historical reality. Model calibration, such as that performed by Farley and Thomann for the Hudson Estuary (Farley, et al., 1999) and by other individuals performing PCB modeling throughout the country (TAMS, Limno-Tech, et.al., 2000; Wisconsin DNR, 2001; Beach, et.al., 2000), is a prerequisite to applying the model as a prognostic tool. During calibration, inputs are adjusted until the model reproduces a predefined set of historical observations. Values assigned to key inputs must fall within known or reasonably expected ranges. If calibration can only be accomplished using unconstrained values, then critical physical processes are likely not being modeled correctly, or inputs (such as from point and non-point sources) to the system have not been properly defined. An improperly calibrated model is not likely to be a reliable prognostic tool for situations different from those used for the calibration.

The Model's results are heavily dependent on the exchange of materials and flows between the main-stem of the Estuary and the tributaries and the atmosphere (i.e.

"boundary conditions") and the assumed distribution of PCBs and sediment composition throughout the Estuary at the start of the simulation (the "initial conditions"). Thus, calibration requires "boundary conditions" that represent actual inputs. For prognostic applications, the "initial conditions" for the concentrations of PCBs and organic material in the sediments are of paramount importance since they will significantly affect the long-term response of the Estuary to proposed management plans for regulating the discharge of PCBs from point and non-point sources.

B. Issues/Proposed Solutions

The Coalition has identified 9 important, time-specific issues that need to be addressed as part of the PCB modeling effort. These issues relate to or can be described as follows:

(1) Model Calibration
(2) Active Sediment Layer
(3) Particulate Organic Carbon Balance
(4) Air/Water Flux
(5) Delaying Incorporation of Zone 6
(6) Identification and Quantification of Point and Non-Point Sources
(7) Food Chain Evaluation
(8) Establishing Appropriate Targets for the TMDL
(9) Uncertainty Evaluation and Sensitivity Analysis

These critical issues, the implications of not addressing them, and proposed approaches for resolving them are discussed in greater detail in the remainder of this document. Given its focus on critical and/or time-sensitive modeling issues, the list above is not intended as a comprehensive list of all technical issues that ultimately need to be addressed in the TMDL process.

1. MODEL CALIBRATION

Issue: The current version of the DRBC PCB Homolog model has not been calibrated to reasonably reproduce the long-term temporal variation of PCB concentrations in the water column and sediments. Instead, the modeling development to date appears to be focusing on the final equilibrium condition.

A thorough understanding of the model's predictive strengths and weakness, and the sensitivity of its calculations to uncertainties in critical inputs (such as PCB loadings from various sources) cannot be gained in the absence of a credible calibration. This understanding can only be achieved if the model is calibrated to reproduce the long-term temporal variation of PCB concentrations in the water column and sediments. Calibration based on comparisons of predicted versus measured observations over short-term periods is insufficient because the complexity of the PCB issue involves too many degrees of freedom (e.g., water column exchange rates, interchange of shallow and deep sediments, the long-term – rather than short-term – effect of changes in concentrations of PCBs in the environment on PCB levels in fish tissue).

Implications: Current concentrations of PCBs in the Estuary sediments will have a significant impact on the Model's calculated response for use in regulating PCBs loadings from point sources and non-point sources. Based on studies for other waterbodies (Farley, et al., 1999; Wisconsin DNR, 2001), this predicted response could reflect the presence of PCBs for periods that are measured in decades. If the issue of "legacy sediments" is not understood and properly addressed in the Model, the Model will not accurately predict the time it will take for the Estuary to come into compliance with applicable water quality criteria.

The final equilibrium condition essentially excludes historical sediment contamination as a relevant factor in the derivation of a TMDL for PCBs. The Model cannot be expected to be a reliable management tool if it cannot reasonably simulate the processes (i.e. tidal hydrodynamics and transport of sediments, carbon and PCBs) governing temporal changes over the long-term fate and transport of PCBs. Assuming no action is taken to reduce PCB loadings to the Estuary, DRBC's last diagnostic test**,** the First Cut Homolog Model (DRBC, 2001), predicts that some zones of the Estuary would experience approximately a ten-fold reduction in the concentration of PCB penta homolog concentrations in the water column and sediments in only 1 year. This prediction is inconsistent with the rate of decline of PCB contamination in sediments, such as the Hudson River (Farley, et al., 1999), and with the much slower rate of decline in the concentrations of PCBs in fish tissue from 1970 to 2000 for the Estuary (Fisher, 2000).

Proposed Solution: The Model must be tested using a true time-variable analysis. The model should be run using a reasonable best estimation of historical loads/conditions, over the past 2 to 3 decades. Model results should be compared to the current state of PCBs in the Estuary. The DRBC should identify and justify:

1) the periods of time for which the Model's predictions will be compared to actual observations,

2) the types of comparisons (i.e. prediction versus observation) that will establish the Model's ability to predict the fate and transport of PCBs,
3) the various inputs (for specifying boundary conditions and initial conditions) that will be used to perform the calibration, and
4) the uncertainties in the inputs.

The DRBC should confirm that all data suitable for calibrating the model, including a true time variable analysis, have been identified. Historical fish tissue data and data characterizing the longitudinal distribution of PCBs in surficial sediments should be used for the calibration. If the available data are not sufficient, additional data would have to be obtained. In that event, the Coalition recommends that the DRBC:

1) Develop a database of the spatial distribution of cesium 137 by initially taking 10 to 20 sediment cores (non-bioturbated) throughout the Estuary. Depending on the spatial variability of the concentrations of cesium 137, additional cores may have to be collected and analyzed.
2) Develop a database of historical PCB, sediment and organic loadings starting from the mid-1960s, i.e. when atmospheric deposition of cesium 137 peaked.
3) Develop a database for determining the current concentrations of PCBs in sediments, in conjunction with the program for collecting data on cesium 137.

2. ACTIVE SEDIMENT LAYER

Issue: The active sediment layer defines the spatial extent and depth of surficial sediments where biological activity promotes the exchange of PCBs between the water column and sediment. It is a key variable affecting the length of time that concentrations of PCBs in the water column will continue to be dependent on historical loadings. In addition, aquatic life will continue to be exposed to PCBs in contaminated sediments.

DRBC initially assumed the depth of the active layer to be approximately 5 centimeters throughout the Estuary, but did not provide representative data to substantiate this assumption. More recently, the DRBC has stated that the Estuary is mostly scoured (i.e., not depositional), based on their preliminary review of new data that have not been provided to the Coalition for review. In contrast, historical investigations have indicated that the Delaware is similar to most estuarine system, with significant depositional areas.

***Implications*:** If the depth, composition, and spatial variability of the active layer are not characterized properly throughout the Estuary, then the overall PCB loading to the Estuary will be misstated, the relative contributions of all sources will be incorrect, the estimated time to clean up the Estuary will be wrong, and implementation strategies will be ineffective.

***Proposed Solution*:** To the extent practical, the DRBC should use the existing data (including historical data) to define the spatial variability of the active layer. If these data are not adequate, then the most sensible and scientifically acceptable way to quantify the active layer is to collect sediment cores, and measure the depths of penetration and distributions of cesium 137 within the cores. Initially, 10 to 20 cores should be taken in areas of known deposition, and the results reviewed to determine the scope of any additional sampling that might be needed. Cesium 137 is a product of nuclear testing that was performed in the 1960's and is often found in buried sediments. As such, it is a useful tracer for measuring total sedimentation since the 1960's. The depth of the cesium penetration can be used to estimate the average long-term sedimentation rate. In addition, the vertical distribution of cesium 137 can be used to estimate the depth over which organisms move deeper sediments to the sediment surface and vice versa. This depth is a reasonable estimate of the active layer.

3. PARTICULATE ORGANIC CARBON BALANCE

Issue: Particulate organic carbon ("POC") has been recognized as playing an important role in the distribution of hydrophobic organic chemicals between the dissolved and particulate phases. A POC balance is an important component of a contaminant transport and fate evaluation because, to a significant degree, PCBs are found with POC. The DRBC has recently indicated that the Model will be based on POC, which the Coalition believes is appropriate. There are other related issues that need to be considered, however, such as the burial of PCBs by bulk solids and algal POC production.

Implications: The transport of PCBs is significantly affected by POC transport. Accurate estimates of current and future contributions of PCBs in sediments, including burial and resuspension, need to be derived so that the Model accurately tracks the transport of POC and PCBs.

Proposed Solution: The existing eutrophication model for the Estuary could be used to estimate POC sources from algal production. In the absence of a solids balance, burial rates could be derived from analysis of dated cores of sediments. These are important features that should be realistically represented in the Model if reasonable POC and PCB transport is to be calculated.

4. AIR/WATER FLUX

Issue: Transfer of PCBs between the water column and the atmosphere may be an important fate and transport process for PCBs in the Estuary, but the rate and overall direction of transfer has not yet been determined.

Implications: PCBs may deposit from the air onto the Estuary, or volatilize from the Estuary into the air. Thus, the atmosphere may represent an overall source or sink of PCBs relative to the Estuary. The Model cannot be properly calibrated until the overall direction and rate of PCB transfer between the Estuary water column and the atmosphere has been determined. Significant errors in the PCB air/water flux would have to be compensated in the Model by artificially increasing or decreasing contributions from other sources and/or increasing or decreasing the exchange of PCBs between the sediments and water column. These types of "forced fixes" would result in an incorrect overall PCB budget, and cause the Model to be unreliable in deriving a TMDL or performing a waste load allocation.

***Proposed Solution*:** Data from the Eisenreich *et al.* studies of air/water fluxes of PCBs along the Estuary should be carefully reviewed. If the data quality is acceptable, then the results of the Eisenreich *et al.* studies should be incorporated into the Model to quantify the rate and direction of PCB transfer between the water surface and the air. To the extent that elements of the First Cut Homolog Model (DRBC, 2001) relating to atmospheric transfer are retained, they should be refined to better represent Estuary conditions. For example, it is inappropriate to characterize the surface water velocity using an "average" long-term flow in predicting potential volatilization. The average long-term flow does not account for tidal effects and therefore underestimates instantaneous water velocities and corresponding volatilization rates.

5. DELAYING INCORPORATION OF ZONE 6

Issue: Delaying incorporation of Zone 6 from the Fate and Transport Model could significantly affect results for portions of the study area. Excluding Zone 6 from the model domain will require DRBC to assign boundary conditions at the downstream end of Zone 5 for each state variable, including PCBs. The assignment of these boundary conditions will be important since they will affect the computed concentrations throughout Zone 5 and, at times, into portions of Zone 4 (as evidenced by intrusion of conservative tracers measured in DRBC boat runs [HydroQual, 1998]).

Implications: In the calibration effort, the assigned concentrations at the downstream end of Zone 5 will need to be based on reliable data since this assignment will affect computed concentrations within Zone 5. To the extent that the boundary conditions at the downstream end of Zone 5 are influenced by sources (sediment, point, or non-point) within the model domain, adjustments to the boundary conditions will be required in projection analyses to properly represent the effect of a loading reduction from an internal source category. Improper adjustment of the boundary concentrations will over- or under-state the response of the system, particularly in lower Zone 5, to internal loading reductions.

Proposed Solution: DRBC should confirm that available data are adequate for assigning of the boundary condition at the downstream end of Zone 5. DRBC should also present the scheme that will be used to link changes in boundary conditions to changes in internal PCB loadings.

6. IDENTIFICATION AND QUANTIFICATION OF POINT AND NON-POINT SOURCES

Issue: Characterizing PCB loadings from watershed non-point sources - including storm water runoff, combined sewer overflows ("CSOs"), Superfund sites, RCRA facilities and other contaminated sites - has not received an adequate level of attention and is not being pursued at a pace that will support the calibration of the Model. A plan for determining PCB loadings from storm water runoff and CSOs has yet to be developed. In addition, procedures for addressing how loadings will be calculated from the many point sources with measurements that consistently show non-detects or indicate the mere presence (but not the concentration) of PCBs have not been developed.

***Implications*:** The calibration of the Model requires identifying and quantifying the loading rates from all the relevant point and non-point sources. Failure to properly inventory one or more categories of potential major sources can be addressed only by artificially biasing the key physical processes governing the fate and transport of PCBs (with the potential consequence of masking serious model deficiencies), and/or arriving at an incorrect understanding of source attribution. More importantly, meaningful efforts to calibrate the Model cannot commence in earnest until PCB loadings from the tributaries, storm water and dry weather runoff, and contaminated sites are adequately quantified. Finally, unless a complete and accurate inventory of PCB loading rates is assembled, the Model cannot be used to derive a reliable estimate of a TMDL and be accepted as a credible tool for wasteload allocation.

***Proposed Solution*:** As seen from other PCB investigations across the country, the loadings from these other non-point sources often dwarf the loadings from point sources. To achieve a more accurate understanding of the sources of PCB loads to the Estuary, the DRBC should:

- Conduct a literature search on available data for PCB loadings from CSOs, storm water runoff, and non-point sources.
- Perform a bounding analysis of non-point source/CSO/storm water loadings to the Estuary based on high-end values derived from the literature for similar areas.

This issue should also be discussed by the Modeling Experts Working Group to tap prior experience and expertise on quantifying PCB loadings from point and non-point sources.

7. FOOD CHAIN EVALUATION

Issue: Measurements of PCBs in fish tissue and the water column, by themselves, can lead to significant error in estimating bioaccumulation factors ("BAFs"), because water column concentrations can have significant short-term variation that will not be reflected in the fish. In addition, for fish that are directly exposed to the sediments, (e.g., eel and catfish), BAF values based on instantaneous water column concentrations are an inappropriate measure of long-term PCB uptake.

Implications: The BAFs obtained from instantaneous measurements will have a large margin of error. Historical calibration will be dependent on average BAFs. PCBs measured in American Eel and White Sucker near Trenton (Fischer, 2000) show an approximate ten-fold decline in concentrations over periods of approximately 15 and 20 years, respectively. This type of fish tissue data reflects the integration of exposure concentrations over a time period of more than 30 years.

Proposed Solution: A food chain model, based on site-specific knowledge of the food chain, that explicitly couples water column and sediment concentrations to fish concentrations should be used to help evaluate the collected data. Long-term fate and food chain model simulations should be performed to calibrate the Model before it is used to support decisions in the TMDL process.

8. ESTABLISHING APPROPRIATE TARGETS FOR THE TMDL

Issue: The target concentrations in fish tissue and the water column to be used in developing the TMDL have not yet been defined. Appropriate targets should be established to help guide the Model development process. For example, the levels of precision and acceptable levels of uncertainty that the Model needs to achieve are dictated in part by the magnitude of the target concentrations. In addition, the form of the target (e.g., "total PCBs") may not be consistent with the level of modeling (e.g., homolog-specific).

DRBC's current numerical water quality standard ("WQS") for total PCBs was adopted in October 1996. DRBC plans to revise these WQS based on an evaluation of the most recent toxicity data for PCBs, guidance regarding fish consumption rates, and other factors that affect the calculation of the standards. In revising the WQS, DRBC also plans to incorporate the results of the on-going study by the Academy of Natural Sciences on the relationships between PCB levels in target fish species and concentrations in other organisms, sediments, and the water column in the Estuary. Differences in potential bioaccumulation between the various homologs and congeners of PCBs will be considered by DRBC in developing the WQS.

Implications*:* PCB targets based on assumptions and/or risk management goals that are not sufficiently stringent may result in an inability to eventually remove fish consumption advisories in portions of the Estuary. On the other hand, PCB WQS based on an overly conservative set of assumptions and/or risk management goals may not be achievable, consistent with other regulatory programs, or be necessary to reduce potential risks to acceptable levels.

At recent Water Quality Standards Subcommittee meetings, a conservative set of "high end" assumptions were discussed as the possible basis for estimating exposures to PCBs in fish tissue. If these values are used along with current EPA toxicity values for PCBs, then the PCB target in fish tissue is calculated to be approximately 2 parts per billion (ppb). This fish tissue target would then be combined with a BAF (planned to be derived from on-going accumulation studies in the Estuary) to calculate a corresponding Water Quality Standard for PCBs in the Estuary.

The proposed target concentration of 2 ppb in fish tissue is well below consumption advisory levels that have been established for PCBs in fish tissue in the DRBC region. For example, the following advisories have been issued:

- FDA tolerance level: 2,000 ppb
- Delaware: 24 ppb (most stringent screening level)
- Pennsylvania: 50 ppb (unrestricted consumption)
  1,890 ppb (do not eat)
- New Jersey: Honors Delaware and Pennsylvania advisories

Thus, a 2 ppb target in fish tissue would be between 10-fold and 1000-fold more stringent than the range of values currently used as advisories for fish consumption in the region.

A 2 ppb target is even below levels detected in fish in remote areas far from residential, commercial, or industrial development. For example, the Agency for Toxic Substances and Disease Registry ("ATSDR") reports the following mean PCB concentrations in fish sampled in remote areas between 1989 and 1997 (ATSDR 2000):

- Char, Artic Quebec: 152 ppb
- Trout, Alaskan Artic: 7 ppb
- Grayling, Alaskan Artic: 1 ppb
- Lake Trout, Sierra Nevadas: 18 – 430 ppb
- Kokanee, Sierra Nevadas: 13 – 44 ppb
- Lake Trout, Siskiwit Lake: 40 – 460 ppb

According to ATSDR (2000), the source of the PCBs for these remote regions is likely to be atmospheric deposition, since there are no known industrial or agricultural sources. Thus, a fish tissue criterion calculated using the combination of high-end assumptions that have been proposed for the Estuary is more than 100-fold lower than some of the concentrations reported in remote areas of North America, which are believed to be impacted only by atmospheric deposition.

***Proposed Solution*:** The PCB targets for the TMDL should be aimed primarily toward allowing for the elimination of fish consumption advisories in the Estuary. Precedent established in other relevant situations (e.g., the Great Lakes, Hudson River, Fox River, Kalamazoo River, Commencement Bay, Green Bay, Sheboygan River, etc.) should be reviewed and considered in setting the targets. For example, a staged approach to achieving interim targets may be appropriate, depending on the final WQS established by DRBC. As part of the two-day scientific workshop, time should be put aside to address this issue and other recognized professionals in this area should be invited to assist us in the discussion.

9. UNCERTAINTY EVALUATION AND SENSITIVITY ANALYSIS

Issue: There will be uncertainties associated with the PCB Model results. These uncertainties will stem from a variety of sources, including limitations in the input data to the Model and the use of relatively simple mathematical algorithms to represent complex fate and transport processes. It will be critical to evaluate the potential significance of these uncertainties, and their effect on management decisions that may be made based on the Model results. If the uncertainties are unacceptably high (e.g., reasonable changes in assumptions would significantly effect management decisions), then it will be necessary to identify how the Model can be refined, or what additional data needs to be collected, to reduce those uncertainties to acceptable levels.

***Implications*:** It is likely that the target for the PCB TMDL will be extremely low. Thus, small changes in input assumptions or data may have profound effects on conclusions based on the results of the modeling (e.g., in identifying sources that appear to contribute to exceedences of the target). If the uncertainties are too large, then the Model will not have the resolution necessary to reliably identify significant sources and pathways of PCBs in the Estuary, or develop the most effective management approaches. Thus, the goals of the TMDL will not be achieved if the uncertainties of the Model are not adequately understood and addressed.

***Proposed Solution*:** The Model should be subject to quantitative sensitivity analyses, to determine if uncertainties may materially affect risk management decisions. Data used in the Model should be collected, evaluated and interpreted relative to current EPA guidance, including:

- *Guidance for Data Quality Assessment* (July 2000),
- *Guidance for the Data Quality Objectives Process,* (August 2000)

Key concepts embodied in these guidance documents include the explicit identification of data uses, development of decision rules for the data, and specification of tolerable limits on decision errors. For example, qualified data and non-detect values should be treated properly in the modeling, and the uncertainties associated with such data carefully evaluated.

IV. CONCLUSIONS

Based upon a review of available data, and discussions among the scientists and modelers involved in the TMDL process, the Coalition recognizes that DRBC understands that many technical and scientific issues have been identified that require resolution. Nevertheless, a process for the timely sharing of data and information fundamental to the development of the TMDL has not been established and interactions among the experts, including the Expert Panel, have not been frequent enough. As a result, the talent and experience of these experts have not been effectively utilized to date. Establishing a collaborative process that would include frequent work sessions to resolve the thorny technical issues and to share data, information and work products will be a major step forward in developing a scientifically sound model of PCB fate and transport in the Estuary. Such a collaborative process will also create efficiencies in the Model development, which, in turn, will increase the likelihood of the TMDL being established within schedule.

To this end, the Coalition urges the DRBC to authorize the Expert Modelers Work Group to begin to work on the critical issues outlined in this document and other issues they may identify, to evaluate the proposed solutions, and to develop recommendations to the DRBC for addressing these issues.

REFERENCES

1. Farley, K.J., Thomann, R.V., et al., 1999. An Integrated Model of Organic Chemical Fate and Bioaccumulation in the Hudson River Foundation. Prepared at Manhattan College, Riverdale, NY, for the Hudson River Foundation. march.

2. HydroQual, 1998. Development of a Hydrodynamic and Water Quality Model for the Delaware River. Prepared for the Delaware River Basin Commission, May 1998. DO Model Report.

3. Maybek, 1982. Phosphorus Transport by World Rivers. American Journal of Science, Vol. 282, April 182, pp 401-450.

4. Fisher, J., 2000. Memorandum from J. Fisher, USGS, to DRBC Toxics Advisory Committee. December 8th, 2000.

5. Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for PCBs. November.

6. Delaware River Basin Commission, "First Cut Homolog Model (FCPHM) of the Delaware River Estuary", December 17, 2001

7. DiToro, D.M., 2002. Presentation to the Delaware Estuary PCB TMDL Expert Panel. West Trenton, NJ, February 12, 2002.

8. Wisconsin Department of Natural Resources, 2001. Development and Application of a PCB Transport Model for the Lower Fox River. Prepared as part of the Lower Fox River/Green Bay Remedial Investigation and Feasibility Study, June 15, 2001.

9. TAMS, Limno-Tech, Menzie-Cura, and TetraTech, 2000. Volume 2D – Revised Baseline Modeling Report, Hudson River PCBs Reassessment RI/FS. Prepared for USEPA Region 2 and USACE, Kansas City District, January 2000.

10. Beach, R.B., et.al., 2000. Modeling Framework Design – Modeling Study of PCB Contamination in the Housatonic River. Prepared for USACE and USEPA, October, 2000.

ATTACHMENT A
Draft Proposal for a Technical Workshop/Science Forum

Progress Toward a Scientifically Credible TMDL for PCBs in the Delaware River Estuary

At the May 2002 meeting of the DRBC Toxics Advisory Committee ("TAC"), the Coalition recommended that a Technical Workshop/Science Forum be organized. The primary purpose of this workshop is to create an opportunity for the Principal Investigators ("PIs") to present the results from recent studies and for workshop participants to discuss the importance of these results for the development of a scientifically credible TMDL model. The Coalition will sponsor and fund this workshop. The TAC agreed that such a workshop would be valuable and Dr. Steve Brown (Rohm and Haas Company) was asked to coordinate the organization of the workshop. An Organizing Committee for the Technical Workshop/Science Forum is being formed and is proposed to include:

Steve Brown	Rohm and Haas Company
Tom Fikslin	DRBC
Rick Greene	State of Delaware
Vick Bierman	Limno-Tech, Inc.
Rollie Hemmitt	USEPA

This technical workshop will include participants (invited experts and stakeholders) who have been active in the process thus far (e.g., through attendance at DRBC TAC and Expert Panel meetings), plus those who are relatively new to the project (e.g., Limno-Tech, HydroQual, Dr. Martin). Those attending the workshop will participate by asking questions about the research findings, and by openly discussing how the data from these studies will help to inform and improve the TMDL model. Workshop attendees will be expected to focus sharply on the value and utilization of the scientific findings, not on related policy issues. Specific objectives of the workshop are to: (1) summarize the data and key findings from recent studies; (2) discuss how these findings can/will be used to inform the model; (3) identify and discuss points of agreement/disagreement regarding the model conceptual framework; and (4) identify any additional data needs. A draft workshop agenda (and rationale) is presented below in order to initiate the planning process.

Technical Workshop/Science Forum

Progress Toward a Scientifically Credible TMDL for PCB's in the Delaware River Estuary

Draft Agenda and Rationale

DAY 1 THE DATA

Session 1 (Morning): Ambient Conditions and PCB Loadings

PCB Concentrations in Water and Sediment (DRBC)
Fish Tissue PCB Concentrations (R. Greene)
Point Source Loadings (DRBC/Coalition)
Non-Point Source Loadings (DRBC/PWD)

Session 2 (Afternoon): Results from Recent Studies

Sediment characterization (Sommerfield)
Air-water-sediment PCB exchange rates (Eisenreich)
Fish feeding preferences (Horowitz)
Food-web interactions and bioaccumulation (Ashley/Baker)

DAY 2 USE OF DATA IN THE MODEL

Session 3 (Morning): Applying Major Findings to the TMDL Model

Generic model conceptual framework for establishing a TMDL for PCBs
- Current model conceptual framework for the Delaware River (DRBC/Limno-Tech)
- Coalition Perspectives on the model conceptual framework (D. DiToro)

Recap major findings and discuss how data being collected can be used to inform the model
- Ambient Conditions and PCB Loadings
- Results from Recent Studies

Synthesis: Points of agreement and disagreement

Session 4 (Afternoon): Identifying Additional Data Needs

Workshop Summary

Rationale for Workshop Agenda

Progress Toward a Scientifically Credible TMDL for PCBs in the Delaware River Estuary

Purpose: Provide an opportunity for the Principal Investigators ("PIs") to present the results from recent studies and for workshop participants to discuss the importance of these results for the development of a scientifically credible TMDL model.

Objectives: (1) summarize the data and key findings from recent studies; (2) discuss how these findings can/will be used to inform the model; (3) identify and discuss points of agreement/disagreement regarding the model conceptual framework; and (4) identify any additional data needs. A draft workshop agenda (and rationale) is presented below in order to initiate the planning process.

DAY 1

Session 1 (Morning): Ambient Conditions and PCB Loadings

This morning session should include a summary of the existing data regarding ambient concentrations of PCB in water and sediment (spatial and temporal distributions), concentrations in fish tissue, and the nature of ongoing sampling programs to document these conditions. The next part of this session would summarize data from the point source discharger sampling and analysis program, and the non-point source sampling and analysis program, again with a description of any ongoing sampling programs to further document these loadings. Each presentation would be 30-40 minutes followed by 10 minutes for questions and answers. Each presentation would include a very brief overview of the questions addressed and the methods used, with the bulk of time focused on the results (data) and major findings.

Session 2 (Afternoon): Results from Recent Studies

The afternoon session would focus on presentations summarizing the results and major findings of recent studies conducted to fill critical data gaps. These studies include those regarding sediment characterization (Sommerfield), air-water-sediment PCB interface exchange rates (Eisenreich), fish feeding preferences (Horowitz), and food-web interactions and bioaccumulation (Ashley/Baker). Each presentation would be 30-40 minutes followed by 10 minutes for questions and answers. Each presentation would include a very brief overview of the questions addressed and the methods used, with the bulk of time focused on the results (data) and major findings.

Rationale for Workshop Agenda

Progress Toward a Scientifically Credible TMDL for PCBs in the Delaware River Estuary

DAY 2

Session 3 (Morning): Applying Major Findings to the TMDL Model

This session would include presentations focused on the conceptual framework for developing a TMDL model for PCBs. A presentation of the generic model structure (conceptual framework) needed to establish a TMDL for PCBs would be useful. This model conceptual framework is not specific to the Delaware River Estuary. In fact, it may be most beneficial for this presentation to be given by someone who can speak entirely apart from the Delaware River and with complete impartiality. It would then be appropriate to ask the DRBC modeling group to present its model conceptual framework for the Delaware River, followed by a similar presentation by the Coalition's modeling expert (HydroQual). In each case, these model conceptual framework presentations would be simple descriptions showing the structural elements of the model, identifying the types of data (boundary conditions, initial conditions, etc.) required for model calibration and verification and emphasizing the interactions of these elements (i.e., boxes and arrows). These presentations would be devoid of actual data/numbers. The presentations would be geared toward what needs to be done, not aimed at critiquing work that has already been done. Each presentation would be 30-40 minutes, with 10 minutes for questions and answers. These three presentations would be followed by a synthesis session (30-45 minutes) aimed at identifying points of agreement and disagreement regarding the model conceptual framework

Session 4 (Afternoon): Identifying Additional Data Needs

This session would begin by revisiting the major findings (take-home messages) regarding ambient conditions/loadings (Session 1) and results of recent studies (Session 2). Each presenter/PI would provide a recap of his/her major findings, followed by a brief discussion of how they feel the data can be used to inform and improve the TMDL model. Each of these presentations will be approximately 15 minutes followed by 15-30 minutes of open discussion on the application of the results to improving the TMDL model.
Session 5: Identifying Additional Data Needs

This brief afternoon session would focus on identifying any additional data gaps, and the basis for any additional data needs should emerge from previous discussions. Any recommendations for additional data collection would be substantiated with evidence that failing to do so would significantly undermine the scientific credibility of the TMDL model. This session would require no more than 1 hour.

Workshop Summary:

A final session would be held to summarize and document the major conclusions of the workshop including (1) points of agreement and disagreement regarding the model conceptual framework, (2) major findings from recent studies conducted to fill data gaps, (3) how the data from recent studies can be used to improve the TMDL model, and (4) additional data gaps. This summary would require no more than 1 hour.

Notes:

The Organizing Committee will request that all workshop presentations (MS Power Point) be provided to the Organizing Committee at least 2 weeks prior to the date of the workshop so that binders containing presentation slides can be available to participants when they arrive. Additionally, the Organizing Committee will discuss and determine a means for documenting and summarizing discussions that will take place at the workshop.